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PATENT ABSTRACTS OF JAPAN, vol. 7, no. 154 (E-185), 6th July 1983; & JP-A-58 064 051

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Description

This invention relates to the fabrication of semiconductor integrated circuit structures and in particular to the fabrication of the terminal metallurgy required on the surface of such semiconductor structures.

In the semiconductor art terminal metallurgy is usually produced using the so-called lift-off processes, wherein a uniform layer of the terminal metal is laid down over the entire surface of the chip which is coated by a soluble polymer in those places the metal is not to contact the surface of the chip so that by the dissolution of the polymer the metal in the unwanted areas is lifted off the surface of the chip.

Typical lift-off processes are shown in a number of prior art patents, such as for example, U.S. Patent 4,532,002; 4,108,717 and 4,045,594. In these processes metal deposited on the surface of a semiconductor device is lifted off by a dissolving of the underlying organic material.

An improvement to the basic lift-off concept was described in U.S. Patent 4,519,872 which sets forth a lift-off process in which the underlying polymer is thermally depolymerized such that its dissolution can be more quickly accomplished since depolymerized polymer is more easily removed in a solvent.

Another improved lift-off process is described in U.S. Patent 4,428,796 in which the polymer is heated to break the bond between deposited metal and the polymer.

Still another improved lift-off process is in U.S. Patent 4,448,636 which describes a process in which the underlying polymer is heated with radiant energy, such as from a laser, to cause the polymer, under the metal film, to outgass thereby breaking the mechanical bond between the metal film and the resist.

Patent Abstracts of Japan, vol. 7, no. 154 (E-185), 6 July 1983 and JP-A-58 064 051 discloses a lift-off method comprising forming a SiO_2 passivation film on a substrate, opening a hole in this layer, depositing a solder paste on the resulting structure, heating the solder to cause melting of the paste and removing the solder outside the hole, thereby obtaining ultrafine solder electrodes.

US-A-4,273,859 discloses a method of forming raised input/output (I/O) terminals on the top surface of semiconductor elements of a semiconductor wafer. After formation of via openings in the passivation layer, heat-resistant photoresist is laminated to the top surface of the wafer, exposed and barrier metal is deposited thereon. The barrier metal layer and then the photoresist are stripped from the wafer. The same lithographic techniques are used to define openings surrounding the barrier metal liming the via openings. Then a layer of solder is deposited, stripped from the photoresist and heated until it reflows to form raised I/O terminals.

The present invention provides an improved method for the formation and fabrication of terminal metallurgy of integrated circuits. The present invention can utilize various image defining layers, such as polymers or photoresist compositions which do not polymerize significantly at higher temperatures. The present invention also permits reduction in the thickness of the deposited terminal metal layers while still maintaining the thickness of the final metallurgy on the chip. Still further, the process of the present invention permits the removal of the unrequired excess deposited metal from the surface of the underlying insulating image defining layer without removing of the image defining layer, thus providing greater physical protection as well as alpha barrier protection to the underlying wafer and still achieve the necessary exterior, external terminal electrical connections required to properly connect and drive the circuit.

A process is described for selective removal of unwanted metallization from the surface of a semiconductor device. The process comprises the usual deposition of a configurable image defining layer or mask on the surface of the device upon which a suitable metallurgy, such as pad limiting metallurgy (PLM) has already been deposited. The image defining layer is then opened over the metallurgy using standard techniques and coated with a layer of the terminal metal. The coated device is then heated to just above the melting point of the layer of terminal metal on the metallurgy causing the melted metal, through surface tension to form a ball of terminal metal on the metallurgy and to form small globules of metal on the surface of the image defining layer or mask and then permitted to cool. When cooled the image defining layer or mask is removed using the usual procedures. Because the coating of terminal metal is no longer a continuous layer on the surface of the mask, removal of polymer masks can be accomplished in about one-tenth of the time required when compared to a deposited terminal metal layer that is not melted. Also because of the effects of surface tension the terminal metal coating need only be one-half the thickness required under the prior art techniques.

Figs. 1 through 7
show, in section, one sequence of a process embodying the present invention, and

Figs. 8 through 13
show a sequence of a different but preferred process embodying the invention.

The present invention as claimed in independent claims 1 and 5 is particularly used for forming the terminal metallurgy, i.e. contacts and metallic

wiring, on the surface of a semiconductor device and will be described in reference to formation of the final solder contacts found on semiconductor devices.

Fig. 1, shows in section, a portion of a typical semiconductor wafer 20 in which there is provided a number of semiconductor circuits 23 and which has completed all the processing prior to final metallization. This Fig. 1 shows the wafer 20 provided with a suitable insulating layer such as a polyimide layer 21, which, in turn, is provided through known techniques such as photolithographic and etching techniques with a suitable via opening 22 leading to the underlying semiconductor circuit 23. It should be noted that such circuits usually require a multiplicity of such openings in which contacts can be made but, for the sake of illustration only, only the formation of one such contact will be shown. It should also be noted that many insulating materials can be used for this layer and many techniques such as a laser beam cutting or the like could be used to make the required openings therein. Following the formation of this opening 22, a layer 24 of so-called pad limiting metallurgy (PLM) usually a micron (1 micron = 1 μm) or so thick, such as chrome-copper-gold or chrome-copper-chrome, or titanium, or titanium-copper as shown in Fig. 2, is deposited, for example by evaporation or sputtering, over the polyimide and through the opening 22 to contact the underlying semiconductor circuit 23. After this PLM is deposited, as shown in Fig. 3, a suitable image defining layer 25 which may be, for example a photoresist sold commercially under the name of Dupont 2560 or Dupont Riston is applied in a thickness of between 38-100 microns (1.5 to 4 mils). The use of such photoresist for such a purpose is well known to the semiconductor industry. It should be noted that other materials can be used for this purpose such as polyimide, glass, etc. The photoresist is exposed and developed using normal photolithographic procedures, as is well known to those skilled in the art, to create a window 26 overlying the PLM coated via opening 22 provided in the polyimide layer 21. This window 26 is carefully dimensioned to define the contact area of the final deposits of terminal contact material to the PLM. As shown in Fig. 4, following the opening of this window 26 in the photoresist a 125 to 150 micron thick lead-tin deposit 27 is made over the entire surface of the photoresist layer 25 by any suitable deposition technique, such as for example, evaporation. This deposit 27 also forms on the surface of the PLM 24 exposed through the window 26. The lead-tin deposit in the region of the window 26 is less then the thickness of the photoresist layer 25 and is thus shown as the depressed layer 27a. Following this lead-tin evaporation and deposit of layers 27 the coated semiconductor wafer 20 is heated in any suitable manner, which can be for example a suitable oven or other heated chamber (not shown), to a temperature of approximately 360°C which is above the melting temperature of the lead-tin deposit, but below the degradation temperature, i.e. that the temperature below which adverse affects such as oxidation, depolymerization or other significant changes in the material characteristics occur of the polyimide 21 or the photoresist layer 25. It should be noted that such heating of the device must be above the melting point of the metal but below that temperature which will adversely affect the semiconductor circuit 23 or any of the previously deposited materials. Preferably this melting is, in this instance, achieved by heating the coated device in a furnace containing a hydrogen atmosphere at 360°. Because of the confining walls of the photoresist 25 around the opening 26 the lead-tin deposit upon melting forms a terminal solder ball 27b in the opening 26 which upon cooling is fixedly adhered to the underlying PLM layer 24. It should be noted that solder ball 27b has considerably more mass than the deposited layer 27a. This is due to the flowing of the melted material and surface tension in the melted material which causes the ball 27b to pull additional material from the surface of the photoresist. That material which is not attracted into the opening 26 by virtue of surface tension of the ball 27 is caused by the same surface tension to be gathered into a plurality of small globules 29 as shown in Fig. 5.

It should be noted that such heating can be localized on a particular portion of the deposited lead-tin layer by, for example use of a laser or a micro-flame apparatus. Again, the temperature of any of the underlying layers must not be caused to reach the degradation temperature. Still further it should be noted that materials other than lead-tin combinations can be used. The sole requirement being that the melting temperature of the selected material being below that of either the polymerization or degradation temperature of the underlying layers.

Since surface tension causes the lead-tin in the opening 25 to be built-up into heights well above the photoresist thickness the need for thick initial accumulations is eliminated and the initial deposit need only be about one-half that of required by prior art techniques. Because the lead-tin deposit on the surface of layer 25, due to surface tension, forms globules 29 on the surface of the photoresist layer 25, extensive portions of the surface of layer 25 are exposed making it more available for rapid chemical stripping. Since the photoresist layer 25 has not been altered by the heating action it can be readily stripped, using a

standard photoresist stripper within a period of between 1 and 4 minutes. Such stripping of the photoresist layer also removes the globules of solder 29 accumulated on the surface while leaving untouched the solder ball 27b, as shown in Fig. 6. After the removal of the photoresist layer 25 the PLM layer 24 of chrome-copper-gold is exposed everywhere except under ball 27b, as shown in Fig. 6. This undesired and now exposed portion of PLM layer 24 can be removed from the surface of the polyimide layer 21 by a standard etch procedure using either potassium cyanide for the gold, ammonium hydrosulfate or ammonium hydroxide plus water for the copper or potassium permanganate for the chrome.

This results in a single solder ball mounted on a remaining portion 24a of the PLM layer 24 which extends through the opening 22 in the polyimide layer 21. The solder ball is now suitable for connection to an external circuit, such as a printed circuit board by conventional means.

Tests performed on such devices using the above described process have found that by slightly tilting the semiconductor wafer at an angle, of about 20° or more, from the horizontal during heating will cause the excess melted solder, to run off the surface of the device leaving only the material contained within the opening 26 in the photoresist. Thus, globules 29 run off the surface of the photoresist. Such globules can also be forced off the surface by using air jets or other such techniques.

Turning now to Figs. 8 through 13, there is described the embodiment preferred by the inventors and which is a variation in the process described in Figs. 1 through 7. Fig. 8 shows a silicon semiconductor wafer 40 having a polyimide layer 41 deposited thereon in which an opening 42 has been previously opened through photolithographic techniques. Following this as shown in Fig. 9 a suitable image defining mask 43 such as photoresist or molybdenum is disposed as previously described over the polyimide 21 so that all of the layer 41 except for a defined region around opening 42 is covered. A pad limiting metallurgy or PLM deposit 44 is now laid down over and around the opening 42 using standard deposition techniques. Subsequently, the mask 43 is removed using standard etching procedures or other removal techniques suitable for the mask used, and as shown in Fig. 10, using standard techniques, a layer of photoresist 45 is laid down on the surface of layer 41. This layer 45 is provided with an opening 46 which is larger than that of the pad limiting metallurgy deposit 44 placed in and around the opening 22 and exposes a ring 47 of the polyimide surface around the PLM deposit 44. This means that photoresist masks need be less restrictive as to matching up to the dimensional aspects of the pad limiting metallurgy. Thus, looser groundrules, i.e. dimensional differences, are permitted to be used with this process as compared to the process described in conjunction with Figs. 1 to 7 and which taught that the photoresist covered a portion of the pad limiting metallurgy.

Following the deposit of the photoresist layer 45 a layer 48 of lead-tin is deposited, by any convenient technique, over the photoresist 45 and the opening 46 as shown in Fig. 11. Following the deposit of the lead-tin layer 48 the coated wafer 40 is heated to melt the layer 48. This melting of layer 48 is accomplished in the manner described in conjunction with Figs. 1 to 7 and forms a ball of solder 48b over the PLM 44. Due to the surface tension of the melted lead-tin layer the portion 48a, deposited in opening 46, contracts from the exposed surface of the polyimide ring 47 around the PLM 44 and collates into a hemispherical ball 48b positioned exactly over and on the PLM 44. Thus no excess lead-tin remains on the exposed polyimide surface 47 within the confines of the photoresist defined opening 46. The remaining deposit of lead-tin on the surface of the photoresist layer 45 is formed by this heating step into globules 49.

Following this heating and balling of the deposited lead-tin layer 48 the photoresist material 45 can be removed by immersing the unit into a standard photoresist removal bath. At that point the device is completed and no further processing is required.

It should be understood that, at times, it may not be necessary to remove the masking material after the heating of the unit especially when the unit is heated in such a way that all the excess metal is caused to run off the surface of the masking material during the heating step.

Thus, there has been described two different processes utilizing image defining masks which are not significantly affected at the temperatures required to melt the lead-tin deposit. Photoresist materials suitable for such a purpose include dry film, such as Dupont Vacrel, Dynachem or liquids such as Ciba-Geigy #348. All of these are particularly useful being suitable for image creation of photolithographic images therein.

The processes described herein permits reduction in the evaporation time by permitting thinner lead-tin alloy deposits and provides for significant surface clearance of the photoresist layer in a brief period while retaining the required terminal pads, thus permitting the stripping of the photoresist to occur in a significantly shorter period of time, i.e., 1 to 4 min., versus approximately 30 min. or more using the prior art techniques.

It should be noted that the resist utilized can be water soluble, halogenated or other types of solvents can be used and which were not usable by the prior art processes.

It should be especially noted that this process can be adapted to produced lines as well as individual pads.

Claims

1. Lift-off process for removing a metallic layer (27, 48,) deposited on a layer of masking material (25, 45) deposited on a semiconductor device (20 - 24, 40, 41, 44) comprising the steps of:
depositing a layer of masking material (25, 45) on the surface of the semiconductor device (20 - 24, 40, 41, 44), the masking material (25, 45), being a photoresist
creating an opening (26, 46) in the layer of masking material (25, 45), and
depositing a layer of metal (27, 27a, 48, 48a) on said layer of masking material (25, 45) and in said opening, said layer of metal (27, 27a, 48, 48a) having a melting point below the degradation temperature of the photoresist (25, 45),
heating said metal layer (27, 27a, 48, 48a) to cause melting of said metal layer (27, 27a, 48, 48a),
and removing said metal (27, 47) outside of said opening.

2. Process of claim 1 wherein the opening (26, 46) in the masking material (25, 45) is created by a photolithographic process.

3. Process of claim 1 wherein said heating is achieved by using a heated chamber.

4. Process of claim 1 wherein said heating is achieved by using a laser beam.

5. Lift-off process for removing a metallic layer (48,) deposited on a layer of masking material (45) deposited on a semiconductor device (40) comprising the steps of:
creating a layer of insulating material (41) on a selected surface of the device (40),
forming openings (42) in selected regions of said insulating layer (41),
depositing a first metallic layer (44) on and around said openings (42),
depositing a layer of masking material (45) on the resulting structure, said insulating layer (41) and said layer of masking material (45) being different polymers,
creating a plurality of openings (46) in the layer of masking material (45), and
depositing a second metallic layer (48, 48a) on said layer of masking material (45) and in said openings (46), said second metallic layer (48, 48a) having a melting point below the melting point of the first metallic layer (44) and below the degradation temperature of the polymers,
heating said second metallic layer (48, 48a) to cause melting of said second metallic layer (48, 48a), and
removing said layer of masking material (45).

6. Process of claim 5 wherein said openings (42, 46) in said insulating layer (41) and said layer of masking material (45) are formed photolithographically.

7. Process of claim 5 wherein said first metallic layer (44) is comprised of chrome-copper-gold or chrome-copper-chrome.

8. Process of claim 5 wherein said second metallic layer (48, 48a) is comprised of lead and tin.

9. Process of claim 5 wherein said layer of masking material (45) is removed from the layer of insulating material (41) by a chemical stripping action.

10. Process of claim 5 wherein said semiconductor device (40) is positioned at an angle of more than twenty degrees to the horizontal while said second metallic layer (48, 48a) is being heated.

11. Process of claim 10 wherein said device is heated in a chamber to a temperature of between 300 °C and 450 °C.

12. Process of claim 10 wherein said second metallic layer (48, 48a) is heated with a laser.

13. Process of claim 5 wherein said insulating layer (41) is composed of a glass.

14. Process of claim 5 wherein said second metallic layer (48, 48a) is approximately one-half the thickness of said layer of masking material.

15. Lift-off process according to claim 5 for removing a metallic layer (48) deposited on a photoresist layer (45) deposited on a semiconductor device (40) comprising the steps of:
creating a layer of insulating material (41) on a surface of the device (40),
forming openings (42) in selected regions of said insulating layer (41),

depositing a first metallic layer (44) on and around said openings (42),
depositing a layer of photoresist (45), having a polymerization temperature and a de-polymerization temperature, on the resulting structure,
photolithographically creating a plurality of openings (46) in the photoresist layer (45), on selected regions on and around said first deposited metallic layer (44),
depositing a second metallic layer (48, 48a) on said photoresist layer (45) and in said openings (46) in said photoresist layer (45), said second layer (48, 48a) having a melting point less than the melting point of said first metallic layer (44) and less than the polymerization temperature and the depolymerization temperature of the photoresist (45),
heating said second metallic layer (48, 48a) to cause melting of said second metallic layer (48, 48a), and
removing said photoresist (45) from the surface of said insulating layer (41) by using a chemical stripping agent.

Patentansprüche

1. Lift-Off-Prozeß zum Entfernen einer metallischen Schicht (27, 48), die auf eine Schicht eines Maskierungsmaterials (25, 45), die auf eine Halbleitervorrichtung (20 bis 24, 40, 41, 44) abgeschieden wurde, abgeschieden ist, mit den Schritten des:
Abscheidens einer Schicht aus Maskierungsmaterial (25, 45) auf die Oberfläche der Halbleitervorrichtung (20 bis 24, 40, 41, 44), wobei das Maskierungsmaterial (25, 45) ein Fotoresist ist,
Schaffens einer Öffnung (26, 46) in der Schicht des Maskierungsmaterials (25, 45) und
Abscheidens einer Schicht aus Metall (27, 27a, 48, 48a) auf jener Schicht aus Maskierungsmaterial (25, 45) und in der Öffnung, wobei die Schicht aus Metall (27, 27a, 48, 48a) einen Schmelzpunkt unterhalb der Zersetzungstemperatur des Fotoresists (25, 45) hat,
Aufheizens der Metallschicht (27, 27a, 48, 48a) zum Bewirken eines Schmelzens der Metallschicht (27, 27a, 48, 48a)
und Entfernens des Metalls (27, 47) außerhalb jener Öffnung.

2. Verfahren nach Anspruch 1, wobei die Öffnung (26, 46) im Maskierungsmaterial (25, 45) durch ein fotolithografisches Verfahren geschaffen wird.

3. Verfahren nach Anspruch 1, wobei das Aufheizen unter Anwendung einer beheizten Kammer erreicht wird.

4. Verfahren nach Anspruch 1, wobei das Aufheizen unter Anwendung eines Laserstrahls erreicht wird.

5. Lift-Off-Prozeß zum Entfernen einer metallischen Schicht (48), die auf eine auf einer Halbleitervorrichtung (40) abgeschiedenen Schicht aus Maskierungsmaterial abgeschieden ist, mit den Schritten des:
Erzeugens einer Schicht aus isolierendem Material (41) auf einer ausgewählten Oberfläche der Vorrichtung (40),
Bildens von Öffnungen (42) in ausgewählten Gebieten der isolierenden Schicht (41),
Abscheidens einer ersten metallischen Schicht (44) auf den und um die Öffnungen (42),
Abscheidens einer Schicht aus Maskierungsmaterial (45) auf die sich ergebende Struktur, wobei die isolierende Schicht (41) und die Schicht aus Maskierungsmaterial (45) unterschiedliche Polymere sind,
Schaffens einer Anzahl von Öffnungen (46) in der Schicht aus Maskierungsmaterial (45) und
Abscheidens einer zweiten metallischen Schicht (48, 48a) auf der Schicht aus Maskierungsmaterial (45) und in den Öffnungen (46), wobei die zweite metallische Schicht (48, 48a) einen Schmelzpunkt unterhalb des Schmelzpunkts der ersten metallischen Schicht (44) und unterhalb der Zersetzungstemperatur der Polymere hat,
Aufheizens der zweiten metallischen Schicht (48, 48a) zum Bewirken eines Schmelzens der zweiten metallischen Schicht (48, 48a) und
Entfernens der Schicht aus Maskierungsmaterial (45).

6. Verfahren nach Anspruch 5, wobei die Öffnungen (42, 46) in der isolierenden Schicht (41) und der Schicht aus Maskierungsmaterial (45) fotolithografisch gebildet werden.

7. Verfahren nach Anspruch 5, wobei die erste metallische Schicht (44) aus Chrom-Kupfer-Gold oder Chrom-Kupfer-Chrom zusammengesetzt ist.

8. Verfahren nach Anspruch 5, wobei die zweite metallische Schicht (48, 48a) aus Blei und Zinn zusammengesetzt ist.

9. Verfahren nach Anspruch 5, wobei die Schicht aus Maskierungsmaterial (45) von der Schicht aus isolierendem Material (41) durch eine

chemische Ablösungswirkung entfernt wird.

10. Verfahren nach Anspruch 5, wobei die Halbleitervorrichtung (40) in einem Winkel von mehr als zwanzig Grad gegenüber der Horizontalen positioniert wird, während die zweite metallische Schicht (48, 48a) aufgeheizt wird.

11. Verfahren nach Anspruch 10, wobei die Vorrichtung in einer Kammer auf eine Temperatur von zwischen 300 °C und 450 °C aufgeheizt wird.

12. Verfahren nach Anspruch 10, wobei die zweite metallische Schicht (48, 48a) mit einem Laser aufgeheizt wird.

13. Verfahren nach Anspruch 5, wobei die Isolierschicht (41) aus einem Glas zusammengesetzt ist.

14. Verfahren nach Anspruch 5, wobei die zweite metallische Schicht (48, 48a) etwa die Hälfte der Dicke der Schicht des Maskierungsmaterials aufweist.

15. Lift-Off-Prozeß nach Anspruch 5 zur Entfernung einer metallischen Schicht (48), die auf eine auf einer Halbleitervorrichtung (40) abgeschiedenen Fotoresistschicht (45) abgeschieden ist, mit den Schritten des:
Erzeugens einer Schicht aus isolierendem Material (41) auf einer Oberfläche der Vorrichtung (40),
Bildens von Öffnungen (42) in ausgewählten Gebieten der isolierenden Schicht (41),
Abscheidens einer ersten metallischen Schicht (44) auf den und um die Öffnungen (42),
Abscheidens einer Schicht aus einem Fotoresist (45), der eine Polymerisationstemperatur und eine Depolymerisationstemperatur hat, auf der sich ergebenden Struktur,
fotolithografischen Erzeugens einer Anzahl von Öffnungen (46) in der Fotoresistschicht (45) auf ausgewählten Gebieten auf der und um die erste abgeschiedene metallische Schicht (44),
Abscheidens einer zweiten metallischen Schicht (48, 48a) auf die Fotoresistschicht (45) und in die Öffnungen (46) in der Fotoresistschicht (45), wobei die zweite Schicht (48, 48a) einen Schmelzpunkt hat, der niedriger als der Schmelzpunkt der ersten metallischen Schicht (44) und niedriger als die Polymerisationstemperatur und die Depolymerisationstemperatur des Fotoresists (45) ist,
Erwärmens der zweiten metallischen Schicht (48, 48a) zum Bewirken eines Schmelzens der zweiten metallischen Schicht (48, 48a) und Entfernens des Fotoresists (45) von der Oberfläche der isolierenden Schicht (41) unter Verwendung eines chemischen Ablösungsmittels.

Revendications

1. Procédé d'enlèvement d'une couche métallique (27, 48) déposée sur une couche de matériau de masque (25, 45) lui-même déposé sur un semi-conducteur (20-24, 40, 41, 44) comprenant les étapes suivantes :
- dépôt d'une couche de matériau de masque (25, 45) à la surface d'un dispositif semi-conducteur (20, 24, 40, 41, 44), le matériau de masque (25, 45) étant un photorésist,
- création d'une ouverture (26, 46) dans la couche du matériau de masque (25, 45), et
- dépôt d'une couche de métal (27, 27a, 48, 48a) sur la couche de matériau de masque (25, 45) et dans ladite ouverture, ladite couche de métal (27, 27a, 48, 48a) ayant une température de fusion inférieure à la température de dégradation du photorésist (25, 45),
- chauffage de ladite couche de métal (27, 27a, 48, 48a) pour entraîner la fusion de ladite couche de métal (27, 27a, 48, 48a),
- et enlèvement dudit métal (27, 47) en dehors de ladite ouverture.

2. Procédé selon la revendication 1 dans lequel l'ouverture (26, 46) dans le matériau de masque (25, 45) est réalisée par un procédé photolithographique.

3. Procédé selon la revendication 1 dans lequel ledit chauffage est réalisé en utilisant une chambre calorifique.

4. Procédé selon la revendication 1 dans lequel ledit chauffage est réalisé à l'aide d'un faisceau laser.

5. Procédé de décollement permettant d'enlever une couche métallique (48) déposée sur une couche de matériau de masque (45) lui-même déposé sur un élément semiconducteur (40), comprenant les étapes suivantes :
- création d'une couche de matériau isolant (41) sur une surface choisie d'élément semiconducteur (40),
- formation d'ouvertures (42) dans des régions choisies de ladite couche iso-

lante (41),
- dépôt d'une première couche métallique (44) sur et autour desdites ouvertures (42),
- dépôt d'une couche de matériau de masque (45) sur la structure résultante, ladite couche isolante (41) et ladite couche de matériau de masque (45) étant constituées de polymères différents,
- création de plusieurs ouvertures (46) dans la couche de matériau de masque (45), et
- dépôt d'une seconde couche métallique (48, 48a) sur ladite couche de matériau de masque (45) et dans lesdites ouvertures (46), ladite seconde couche métallique (48, 48a) ayant une température de fusion inférieure à celle de la première couche métallique (44), et inférieure à la température de dégradation des polymères,
- chauffage de ladite seconde couche métallique (48, 48a) pour entraîner la fusion de ladite seconde couche métallique (48, 48a), et
- enlèvement de ladite couche de matériau de masque (45).

6. Procédé selon la revendication 5 dans lequel lesdites ouvertures (42, 46) dans ladite couche isolante (41) et dans ladite couche de matériau de masque (45) sont formées par procédé photo-lithographique.

7. Procédé selon la revendication 5 dans lequel ladite première couche métallique 44 est composée de chrome-cuivre-or ou chrome-cuivre-chrome.

8. Procédé selon la revendication 5 dans lequel ladite seconde couche métallique (48, 48a) comprend du plomb et de l'étain.

9. Procédé selon la revendication 5 dans lequel ladite couche de matériau de masque (45) est enlevée de la couche de matériau isolant (41) par un décollement chimique.

10. Procédé selon la revendication 5 dans lequel ledit élément semiconducteur (40) est incliné d'un angle supérieur à vingt degrés par rapport à l'horizontale, pendant que ladite seconde couche métallique (48, 48a) est chauffée.

11. Procédé selon la revendication 10 dans lequel ledit dispositif est chauffé dans une enceinte à une température comprise entre 300 degrés C et 450 degrés C.

12. Procédé selon la revendication 10 dans lequel ladite seconde couche métallique (48, 48a) est chauffée au laser.

13. Procédé selon la revendication 5 dans lequel ladite couche isolante (41) est en verre.

14. Procédé selon la revendication 5 dans lequel ladite seconde couche métallique (48, 48a) est d'une épaisseur environ moitié de celle de la couche de masque.

15. Procédé d'enlèvement selon la revendication 5 pour enlever une couche métallique (48) déposée sur une couche de photorésist (45) elle-même déposée sur un semi-conducteur (40), comprenant les étapes de :
- création d'une couche de matériau isolant (41) sur une surface du semi-conducteur (40),
- formation d'ouvertures (42) dans des régions sélectionnées de ladite couche isolante (41),
- dépôt d'une première couche métallique (44) sur et autour desdites ouvertures (42),
- dépôt d'une couche de photorésist (45) ayant une température de polymérisation et une température de dépolymérisation, sur la structure résultante,
- création, par photolithographie, de plusieurs ouvertures (46) dans la couche de photorésist (45), dans des régions sélectionnées et autour de ladite première couche métallique déposée (44),
- dépôt d'une seconde couche métallique (48, 48a) sur ladite couche de photorésist (45) et dans lesdites ouvertures (46) de la couche de photorésist (45), ladite seconde couche (48, 48a) ayant une température de fusion inférieure au point de fusion de ladite première couche métallique (44) et inférieure à la température de polymérisation du photorésist (45),
- chauffage de ladite seconde couche métallique (48, 48a) pour obtenir la fusion de ladite seconde couche métallique (48, 48a), et
- enlèvement dudit photorésist (45) de la surface de ladite couche isolante (41) par utilisation d'un agent chimique.

FIG.1

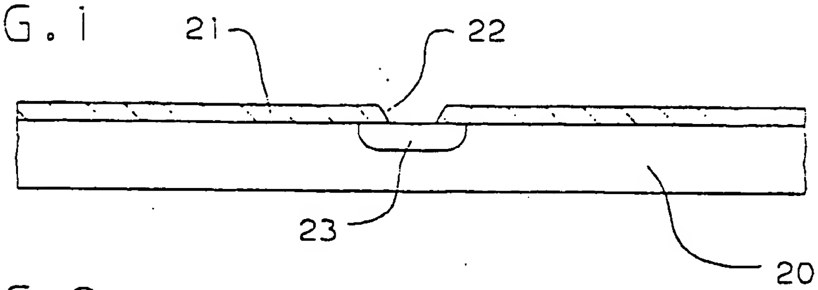

FIG.2

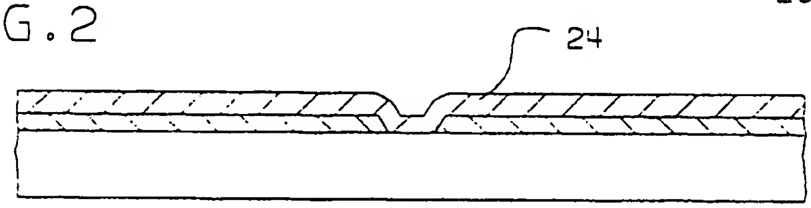

FIG.3

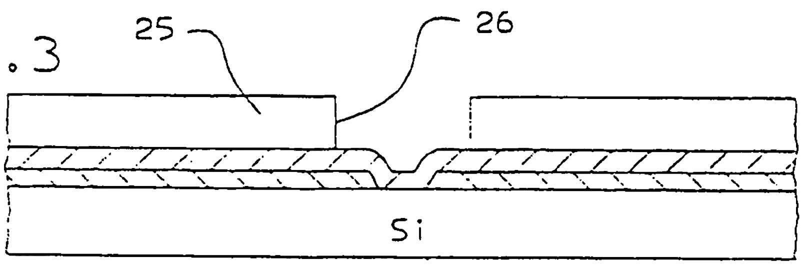

FIG.4

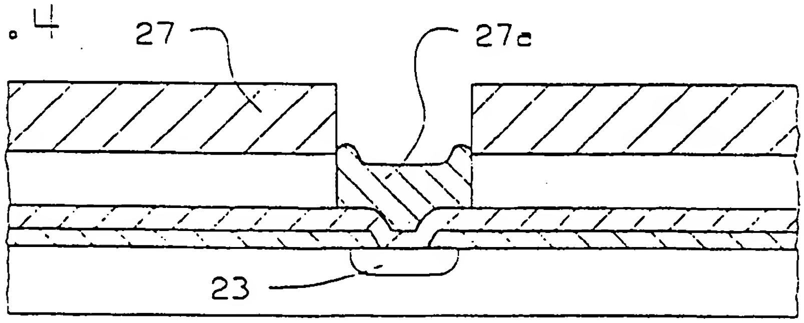

FIG.5

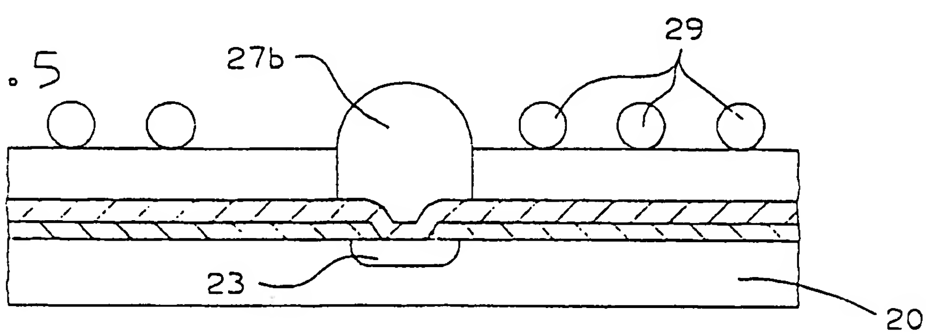

FIG.6

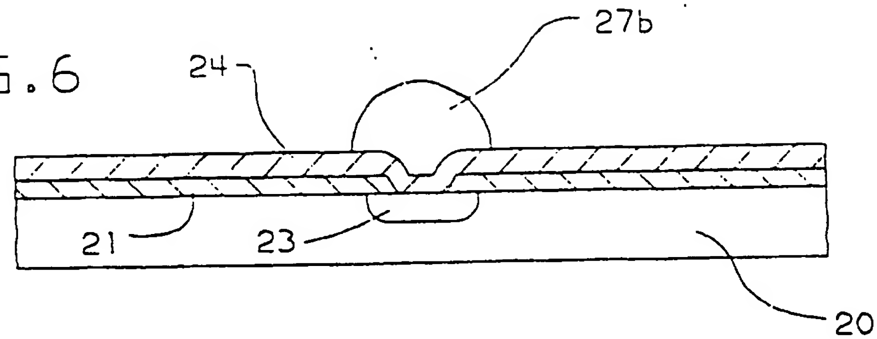

FIG.7

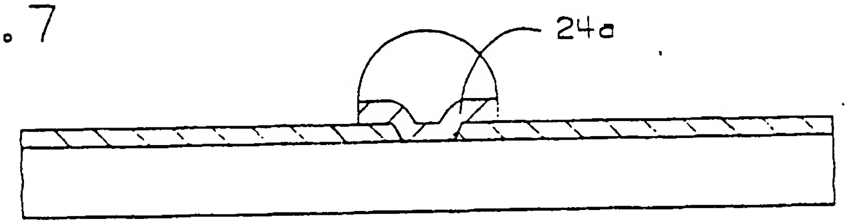

FIG.8

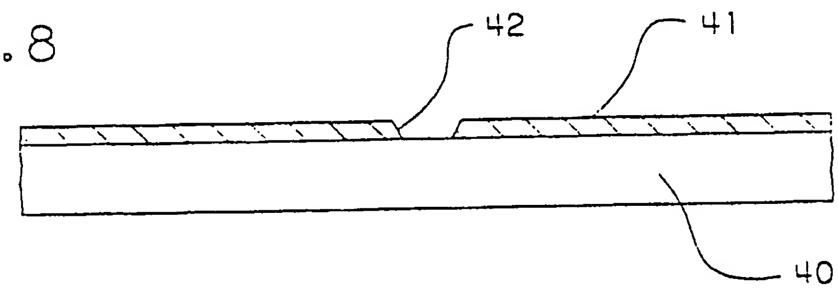

FIG.9

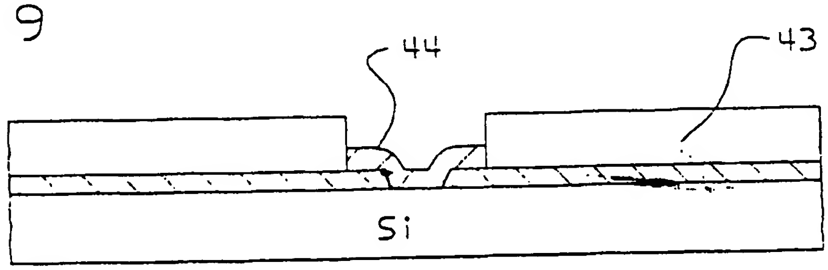

FIG.10

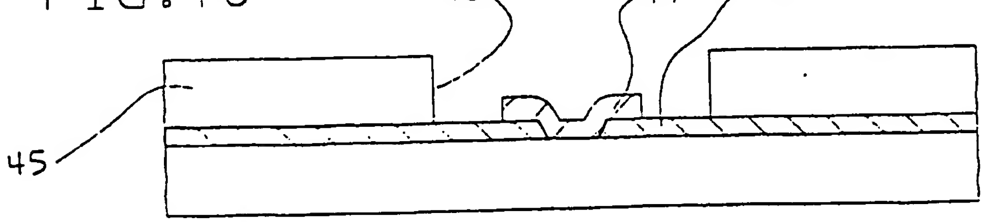

FIG. 11

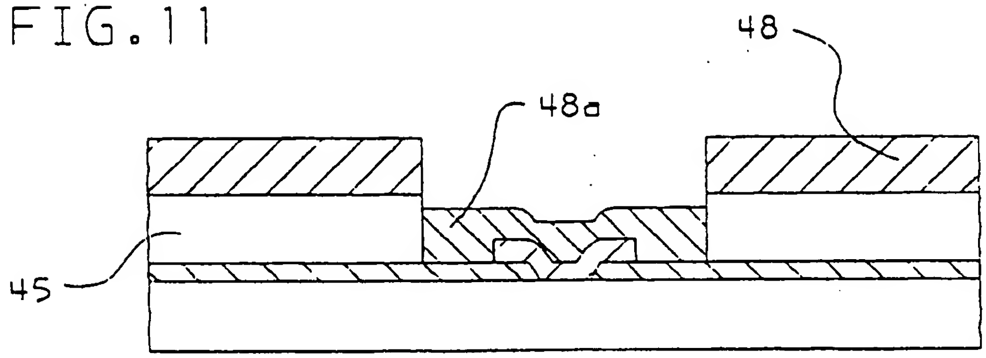

FIG. 12

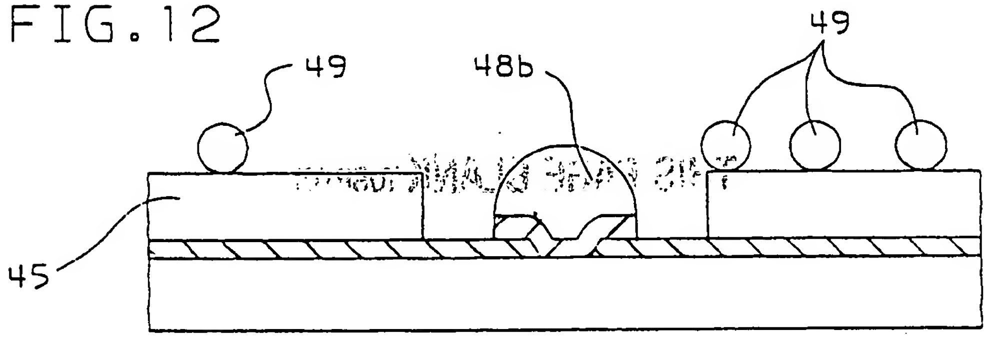

FIG. 13